

**REMARKS/ARGUMENTS**

Claims 1-18 are pending in the Application.

Claims 1-18 stand rejected.

Claims 19-27 are added herein.

**I. DOUBLE PATENTING REJECTIONS OVER CO-PENDING APPLICATION NO. 10/764,092**

The Examiner has maintained the provisional rejection of Claims 1-7 under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-11 of co-pending Application No. 10/764,092 (the '092 Application). Office Action, at 2-3. Additionally, the Examiner has provisionally rejected new Claims 8-18 (added in the response filed February 16, 2006) over the same Claims in the '092 Application. Office Action, at 5.

Applicant respectfully traverses these rejections. Applicant notes that, if the "provisional" double patenting rejection is the only rejection remaining in the Application, then the Examiner should withdraw the rejection and permit the Application to issue as a patent. M.P.E.P. §804.

**II. DOUBLE PATENTING REJECTIONS OVER CO-PENDING APPLICATION NO. 10/738,168**

The Examiner has maintained the provisional rejection of Claims 1-7 under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-28 of co-pending Application No. 10/738,168 (the '168 Application). Office Action, at 3-4. Additionally, the Examiner has provisionally rejected new Claims 8-18 over the same Claims in the '168 Application. Office Action, at 5-6.

Applicant respectfully traverses these rejections. Applicant notes that, if the "provisional" double patenting rejection is the only rejection remaining in the Application, then

the Examiner should withdraw the rejection and permit the Application to issue as a patent. M.P.E.P. §804.

### **III. REJECTIONS UNDER 35 U.S.C. § 103(a) OVER HONG IN COMBINATION WITH WOOD**

Claims 1-9 and 11-18 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Hong *et al.*, “Synthesis of Carbon Nanotubes by Microwave Heating,” *Proc. 6<sup>th</sup> Appl. Diamond Conf./2<sup>nd</sup> Frontier Carbon Technology Joint Conf. (ADC/FCT 2001)*, July 1, 2001, pp. 805-809 (“*Hong*”) in combination with Wood *et al.*, German Patent Application Publication No. DE 3915044 A1 (“*Wood*”). Office Action, at 6-7 and 10.

The Examiner is reminded that, in order to establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a), three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant’s disclosure. *See* M.P.E.P. 706.02(j); *see also* *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

#### **Claims 1 and 8**

Regarding Claim 1, the Examiner states that “[i]t would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the irradiating step described by Hong by irradiating the carbon nanotubes with the microwaves because Hong teaches growing the CNTs (page 807, Fig. 1(b)).” Office Action, at 8. The Examiner further states that “[t]he invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because Hong teaches a similar process as presently

claimed.” Office Action, at 8. A similar statement was made regarding Claim 8. *See* Office Action, at 10-11.

Applicant respectfully points out that *Hong* teaches a method comprising *locally* heating cobalt sulfide catalysts with microwaves in an acetylene atmosphere (*i.e.*, a reactive environment) so as to grow [*multi-wall*] carbon nanotubes (CNTs) on a polymer substrate. *See Hong*, p. 806, *ll.* 6-12. Because such heating is localized at the cobalt sulfide particles, “[t]he substrate is not heated by the microwave [*sic*], so that it is possible to incorporate CNTs with organic polymers in various applications.” *Id.*

In response to the Examiner’s rejection of Claim 1, exactly how the method of *Hong* is to be modified is not clearly articulated by the Examiner. That is, there is no teaching, disclosure, or even a suggestion as to *how* one (of ordinary skill in the art) would alter the experimental procedure of *Hong* from using microwaves to locally heat the cobalt sulfide catalyst particles in an acetylene atmosphere (so as to grow CNTs) to selectively microwaving the CNTs (so as to crosslink them). It is not even evident that such modification could be done in the “flowing reactant gases” in which the microwave irradiating was carried out. *See Hong*, p. 806, *ll.* 39-40. At the very least, *Hong* fails to teach, disclose, or suggest all of the limitations of Claims 1 and 8. The Examiner is reminded the proposed modification cannot change the principle of operation of the prior art being modified, nor can the proposed modification render the prior art unsatisfactory for its intended purpose. *See* M.P.E.P. 2143.01, *see also* *In re Ratti*, 270 F.2d 810, 123 U.S.P.Q. 349 (CCPA 1959) and *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984), respectively.

Examiner appears to argue that the method of *Hong* *inherently* microwaves the CNTs (while they are being grown) to yield a plurality of crosslinked CNTs (*see* Office Action, at 11). Applicants traverse such a position. Because *Hong* is silent about the supposed “inherent” characteristic suggested by Examiner, the Examiner must fill this gap by recourse to extrinsic evidence. *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1269, 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991). “Such evidence must make clear that the missing descriptive matter is *necessarily* present in the thing described in the reference, and that it would be so recognized by

persons of ordinary skill.” *Id.* (emphasis added). Moreover, inherency, may not be established by probabilities or possibilities; the mere fact that a certain thing *may* result from a given set of circumstances is not sufficient to show this feature is present. *Id.* In the present circumstance, the supposed “inherent” characteristic is not supported by any evidence. Applicant points out that there is no evidence that the CNTs of *Hong* were heated by the microwave radiation. Furthermore, there is no evidence that the CNTs of *Hong* were crosslinked. Their transmission electron microscopy analysis (*see Hong*, Fig. 3b) clearly evidences that they had the capability of observing whether such crosslinking had occurred, yet none was reported. Given that this would have been a significant finding, it is implausible that such crosslinking would have been observed but not reported by *Hong*. Thus, the only reasonable conclusion is that no such crosslinking occurred in *Hong*.

As a separate basis of non-obviousness, and in addition to the above arguments, there is also simply no motivation for modifying the method of *Hong* to irradiate the CNTs with microwaves to yield a plurality of crosslinked nanotubes—as required by Claims 1 and 8, and all of the Claims depending therefrom. *Hong* states that “microwave induced reaction [*sic*] made it possible to incorporate CNTs with low melting point materials such as organic polymers,” and that “[i]t may become an important advancement to the fabrication of flexible field emission display [*sic*.]” *Hong*, p. 809, ll. 10-12. Use of CNTs as field emitters in such displays is well established, but crosslinking of the CNTs would introduce defects in the CNTs along their length, intuitively hindering their suitability to function in such a manner. Thus, *Hong* actually *teaches away* from irradiating the CNTs to yield a plurality of crosslinked CNTs, and any modification of *Hong* that leads to crosslinking would render *Hong* unsatisfactory for its intended purpose.

Accordingly, Claims 1 and 8 are not obvious in view of *Hong*. Additionally, all Claims depending therefrom (all remaining Claims so rejected, *i.e.*, Claims 2-7, 9, and 11-18), are not obvious in view of *Hong* by virtue of their dependence, either directly or indirectly, on Claim 1 or 8. *See In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

**Claim 2**

In addition to being non-obvious for the reasons specified above for Claim 1, as regarding Claim 2, the Examiner states that “Hong teaches purging any air in the reactor before the start of the microwave irradiation,” and that “[i]t would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the irradiating step described by Hong with wherein the step of irradiating is carried out in an inert environment selected from the group consisting of ultra-high vacuum, high vacuum, inert gases, and combinations thereof because Hong purged any air in the reactor before the start of the microwave irradiation.” Office Action, at 9.

In response, Applicants respectfully point out that while *Hong* does purge their reactor of air, they do so with a combination of hydrogen, hydrogen sulfide, and acetylene—the very same *reactant gases* used to reduce and sulfide the cobalt catalyst and to grow the CNTs under microwave irradiation, respectively. *See Hong*, p. 806, approx. ll. 37-39. Such reactant gases would not be mistaken, by one of ordinary skill in the art, for an “inert environment,” as required by Claim 2.

Accordingly, Claim 2 is further not obvious in view of *Hong*.

**Claim 7**

In addition to being non-obvious for the reasons specified above for Claim 1, as regarding Claim 7, the Examiner states that “Hong teaches that various shapes of carbons were observed including CNTs, nanofibers, nanoparticles and amorphous carbon,” and that “[t]he invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because the growing of the carbon nanotubes are deemed to inherently crosslink the carbon nanotube material to comprise at least one junction formed via the rearrangement of carbon atoms because similar processes can reasonably be expected to yield products which inherently have the same properties.” Office Action, at 10.

In response, Applicants respectfully point out that the formation of other carbon structures grown by the method of *Hong* has no bearing on whether crosslinking between CNTs would inherently occur so as to form at least one junction. Such structures in *Hong* were *grown* from acetylene, not formed via crosslinking mechanisms. That *Hong* does not inherently crosslink CNTs is addressed above.

Accordingly, Claim 7 is further not obvious in view of *Hong*.

### Claim 9

In addition to being non-obvious for the reasons specified above for Claim 8, as regarding Claim 9, the Examiner contends that while *Hong* does not specifically teach single-wall carbon nanotubes, “[t]he invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because *Hong* teaches a similar process as presently claimed.” The Examiner further contends that “this claim limitation [single-wall carbon nanotubes] is a *result* of performing the method and is not a method step.” Office Action, at 11-12.

In response, Applicants respectfully point out that, based on the diameters and TEM image (Fig. 3b) shown in *Hong*, a person of ordinary skill in the art would understand them to be growing multi-wall carbon nanotubes. A process focused on *growing* multi-wall carbon nanotubes (for field emission devices) is sufficiently distinct from a process of irradiating single-wall carbon nanotubes so as to crosslink them, that Claim 9 is deemed by Applicants to be further not obvious in view of *Hong*. Additionally, Applicants note that the single-wall carbon nanotube claim limitation is *not* a result of performing the method, as the Examiner alleges.

As a result of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 1-9 and 11-18 under 35 U.S.C. § 103(a) as being obvious over *Hong* in combination with *Wood*.

**IV. REJECTIONS UNDER 35 U.S.C. § 103(a) OVER HONG IN COMBINATION WITH WOOD AND FURTHER IN VIEW OF HOLZINGER**

Claim 10 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hong* in combination with *Wood* and further in view of *Holzinger* et al., “Sidewall Functionalization of Carbon Nanotubes,” *Angew. Chem. Int. Ed.* (2001), vol. 40(21), pp. 4002-4005 (“*Holzinger*”). Office Action, at 12.

Regarding Claim 10, the Examiner states that “[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the carbon nanotubes described by *Hong* with wherein the carbon nanotubes are chemically functionalized prior to the step of irradiating because the functionalization of carbon nanotubes would have improved their solubility and processibility as taught by *Holzinger*.”

In response, Applicants respectfully point out that the improved solubility and processibility of functionalized carbon nanotubes taught by *Holzinger* is only relevant to *solution-based* processes. Applicant notes that neither the presently claimed invention nor the process of *Hong* are solution-based.

Furthermore, even if one did functionalize the carbon nanotubes of *Hong*, it would have to be done *after* they were grown (Claim 10 requires irradiating already-functionalized CNTs). Claim 10 requires that “the carbon nanotubes are chemically functionalized *prior to* the step of irradiating.” Application, Claim 10 (emphasis added). Given that *Hong* teaches irradiating when making nanotubes and *Holzinger* teaches functionalizing already made nanotubes, there would be no apparent reason to irradiate the nanotubes after functionalization in view of *Hong*, *Wood*, and *Holzinger*. Thus, in addition to the reasons why Claim 10 is non-obvious since it depends from non-obvious Claim 8 (*see above*), the proper temporal relationship recited in the limitations of the method/process of Claim 10 is neither taught nor suggested by *Hong* in combination with *Wood* and in view of *Holzinger*. And because none of these references, alone or in combination with each other, show all of the limitations of Claim 10, the Examiner has not presented a *prima facie* case of obviousness of this claim. M.P.E.P. § 2142 (“the prior art reference (or references when combined) must teach or suggest all of the claim limitations.”); M.P.E.P. § 2143.03 (“To

establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art."); *see also In re Vaeck*, 947 F.2d at 493, 20 U.S.P.Q.2d at 1443; *In re Thrift*, 298 F3d 1357, 63 U.S.P.Q.2d 2002, 2008 (Fed. Cir. 2002).

As a result of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claim 10 under 35 U.S.C. § 103(a) as being obvious over *Hong* in combination with *Wood* and further in view of *Holzinger*.

**V. ADDED CLAIMS**

Claims 19-27 are added herein. No new matter is introduced as a result of this addition of Claims.

**VI. CONCLUSION**

As a result of the foregoing, it is asserted by Applicant that the Claims in the Application are now in a condition for allowance, and respectfully request allowance of such Claims. Applicant further respectfully requests that the Examiner call Applicant's attorney/agent at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining problems.

Respectfully submitted,

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